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RESPONDING MAINTAINED BY THE OPPORTUNITY TO ATTACK DURING AN INTERVAL FOOD REINFORCEMENT SCHEDULE[1]

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Pigeons responded in a two-key situation. Responses on the right key (food key) were reinforced with food presentation on a response-initiated fixed-interval schedule, (*i.e.*, first response after a fixed period of time was reinforced); responses on the left key (target key) were reinforced on a fixed-ratio schedule (*i.e.*, every nth response was reinforced) with the presentation of a target bird that could be attacked. When the interval value of the food reinforcement schedule was varied from 1 min to 5 min, both the rate of attack responding on the target bird and the rate of responding on the target key were a function of the interval value. Responding on the target key was not maintained by the stimulus change associated with target availability, and was successively extinguished and reconditioned by removing and returning the target bird to the restraining box. When food was delivered independently of behavior, responding on the target key either remained unchanged or decreased, but was not eliminated. Responding on the target key was not maintained in the absence of an intermittent schedule of food presentation.

CONTENTS

A variety of environmental events can produce agonistic behavior. Aggressive-display in the Siamese fighting fish and the fighting cock is elicited by the visual image of another member of the species (Lissmann, 1932; Guhl, 1962). Similarly, presentation of electric shock, heat, or a physical blow elicits aggressive attack directed at animate or inanimate objects (Ulrich and Azrin, 1962; Azrin, Hutchinson, and Sallery, 1964; Azrin, Hake, and Hutchinson, 1965).

Under some conditions, schedules of response-dependent food presentation can also induce aggression. Azrin, Hutchinson, and Hake (1966), and Thompson and Bloom (1966) reported that transitions from the reinforcement of each response to reinforcement omission produced attack in pigeons and rats. During exposure to a fixed-ratio (FR) schedule under which every *n*th response was reinforced, squirrel monkeys attacked an inanimate object (Hutchinson, Azrin, and Hunt, 1968), and pigeons (Gentry, 1968; Cherek and Pickens, 1970) and rats (Gentry and Schaeffer, 1969) attacked live target animals.

Manipulations of reinforcement frequency and/or response requirement also produce corresponding alterations in the frequency of schedule-induced aggression. Hutchinson, *et al.*, (1968) observed that increases in the fixed-ratio response requirement increased frequency of aggressive biting, while decreases in the requirement were followed by a gradual decrease in the aggression. Increases in the interval between response-independent food presentations, likewise, increased the rate of attack in pigeons (Flory, 1969).

Stimuli that can elicit unconditioned aggressive-display have also been shown to serve

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as a reinforcer for an arbitrary operant response. Siamese fighting fish emitted an operant response when that response resulted in their mirror image or a model of a fish in agonistic display (Thompson, 1963). Fighting cocks responded on a fixed-ratio schedule leading to mirror presentation or a visual image of another fighting cock (Thompson, 1964).

Since reinforcement schedules can result in aggressive behavior, the present study was undertaken to determine if presentation of a target that could be attacked would serve as a reinforcer for an operant response during concurrent food reinforced responding. In addition, the effects of changes in the food schedule on responding that resulted in target presentation were investigated.

EXPERIMENT I: RESPONDING MAINTAINED BY THE OPPORTUNITY TO ATTACK AS A FUNCTION OF THE INTERVAL VALUE OF A CONCURRENT FOOD REINFORCEMENT SCHEDULE

METHOD

Subjects

Eight male White Carneaux pigeons were used; four served as experimental subjects and four as targets. Two of the experimental subjects (P 30 and P31) had previous exposure to fixed-interval food reinforcement schedules; the others were experimentally naive. The subjects were maintained at 80% of their free-feeding weight, while target birds had free access to food. Each target bird was paired with a specific subject for the entire experiment. All pigeons were housed in individual cages with water and grit continuously available.

Apparatus

The experimental apparatus was a standard pigeon test chamber (Lehigh Valley Electronics Model No. 1578B), containing two translucent response keys (Lehigh Valley Electronics Model No. 1348) and a food delivery mechanism (Figure 1). Both response keys were transilluminated by a white light. The apparatus for recording aggressive attacks was similar to that described by Azrin, *et al.*, (1966). The target pigeons were restrained in a Plexiglas box by metal bands fastened over each wing. The restraining box was mounted on a metal frame containing an adjustable spring and a microswitch. A force of at least 100g (0.98 N) exerted against the front of this box by the experimental subject resulted in a switch closure. Each switch closure was recorded as an attack response.

The apparatus was located in a ventilated, sound-attenuating chamber. All scheduling and recording were performed by electromechanical equipment located in an adjacent room.

Procedure

Responses on the right key (food key) were reinforced with food presented on a response-initiated fixed-interval schedule (Mechner, Guevrekian, and Mechner, 1963). The first response after reinforcement initiated an interval, and the first response after a fixed period of time was reinforced by 3-sec access to Purina poultry pellets. During food delivery, the magazine was illuminated and the food keylight was extinguished.

Responses on the left (target) key resulted in the presentation of a target bird that could be attacked. A transparent Plexiglas shield, positioned in front of the target animal prevented the subject from gaining access to the target. Responses on the target key produced a 3-sec tone and simultaneously activated a motor that pulled the shield to one side, exposing the target. The shield remained in the open position for 15 sec, and then was closed by a second activation of the motor. During the 15 sec the target bird was accessible, the light on the target key was extinguished and responses on that key were of no consequence. The two keylights were extinguished at different times; the food keylight during food presentation and the target keylight during target bird presentation.

To decrease the possibility that responding on the target key was maintained by adventitious food reinforcement: (a) a changeover delay (COD) ensured that at least 15 sec elapsed between the occurrence of each response on the target key and the presentation of food after a response on the food key (Catania, 1966), and (b) a protective contingency imposed a 15-sec delay between the termination of target availabiilty (*i.e.*, the return of the shield in front of the target) and the reinforcement of a response on the food key. These two contingencies prevented the accidental, temporal association of responding

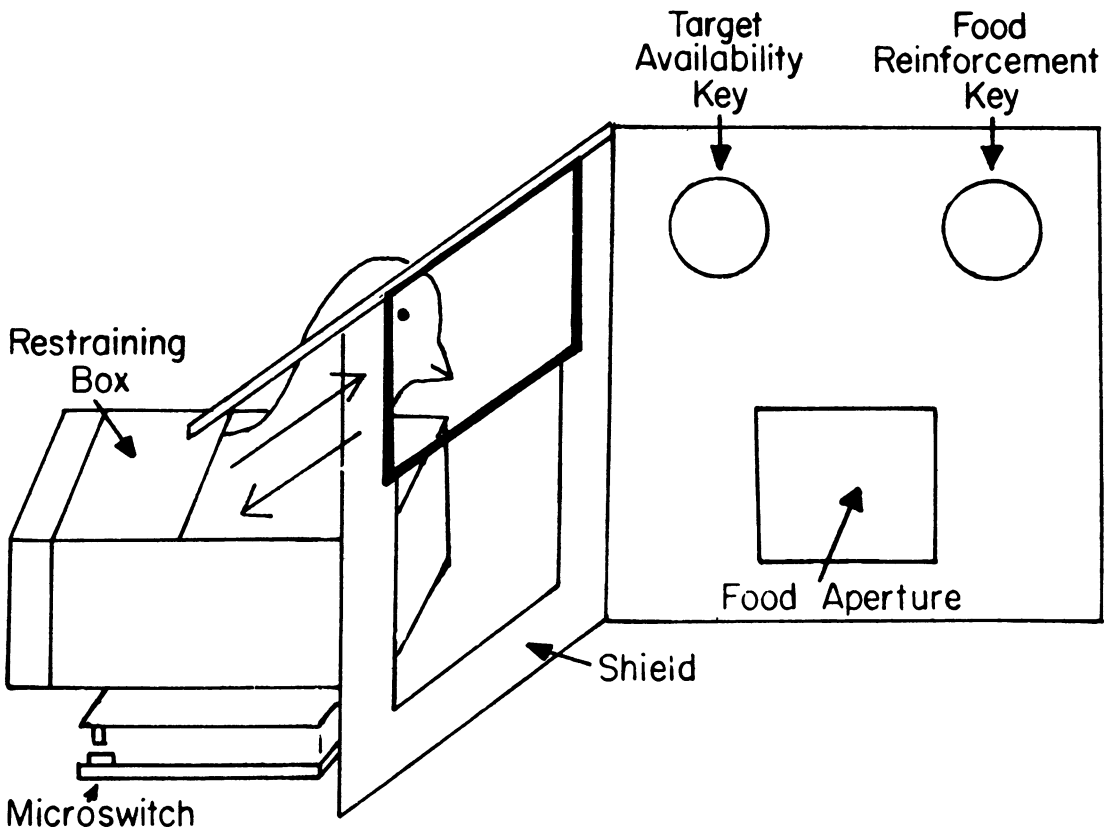

Fig. 1. Schematic illustration of the experimental apparatus. Responses on the target key resulted in the presentation of a target bird that could be attacked. Completion of an FR 2 requirement on the target key, activated a motor that pulled the shield to one side, exposing the target bird for 15 sec (direction of movement indicated by arrows). Responses on the food key were reinforced with food presentation on a response-initiated FI schedule.

on the target key or the termination of target availability with food presentation.

With the two naive subjects (P 17 and P 34), responses on the food key were shaped, and subjects were placed on an FR 1 food reinforcement schedule for three sessions. During subsequent daily sessions, a response-initiated fixed-interval 5-sec schedule (*i.e.*, a tandem FR 1 FI 5-sec) was instated, and the value of the interval was gradually increased from 5 sec to 1 min. The four subjects were maintained on a response-initiated fixed-interval 1-min reinforcement schedule until responding stabilized (8 to 13 sessions). During this training, the target key was covered. Following stabilization, the target bird was introduced, and the target key was uncovered and illuminated. For three consecutive sessions, a single response (FR 1) on the target key resulted in 15-sec access to the target. After the third session, the response requirement on the target key was increased to FR 2, (*i.e.*, two responses were required for access to the target) and remained at that value for the rest of the experiment. The interval value of the food reinforcement schedule was increased from 1 min to 5 min in increments of 1 min, and then decreased through the same sequence to the original value of 1 min. The subjects were maintained at a given interval value for five successive sessions. Daily sessions were terminated after 25 food reinforcements.

Results and Discussion

All subjects began to respond on the target key immediately after it was made available. A sample cumulative record for Subject P 30 responding on FI 2-min food and FR 2 target presentation schedules is shown in Figure 2. Responding on the target key occurred pri-

marily after food presentation. The percentages of target key responses during the post-reinforcement pause of the FI schedule (time between food presentation and the response that initiates the next fixed interval) were: 87% for Subject P 30; 86% for P 31; 89% for P 34; and 84% for P 17.

The percentages of target bird presentations during which one or more attack responses were recorded were: 85% for Subject P 30; 76% for P 31; 93% for P 34; and 87% for P 17. At times when the target was available and no attack responses were recorded, the subjects were observed to emit characteristic threat patterns [*i.e.*, coos, feather erection, pecking at floor, wing flapping, *etc.* (Smith and Hosking, 1955)] which were not followed by actual physical attack. When attacks did occur, they were directed primarily at the head and eyes, as has been described by Azrin, *et al.*, (1966). The target birds made vigorous defensive movements when the Plexiglas shield began to open, and occasionally while the door was closed. The recording of switch closures (on separate counters) while the door was closed revealed that such movements by themselves failed to activate the microswitch.

Figure 3 shows the mean rate of responding on the target key and the mean rate of attack responses as a function of the interval value of the food reinforcement schedule. The rates plotted at the various interval durations represent the mean of the last three sessions; sessions during the initial exposure to the interval, and sessions during the replication in the descending series of intervals are plotted separately. The mean response rates at an interval value of 5 min were based on only three sessions. Response rates during the descending series were slightly lower than those observed during the initial increasing series. Both the rate of attack responses and the rate of responding on the target key were a function of the interval value. The highest rate of both responses occurred at an interval value of 2 or 3 min. Two subjects (P 17 and P 31) showed the highest rate of attack and responding on the target key at an interval of 2 min, while the highest rates were observed at 3 min for Subjects P 30 and P 34. Both rates showed similar changes as a function of interval value, so that an increased or decreased rate of responding on the target key at a particular interval value was accompanied by a corresponding increase or decrease in the attack rate.

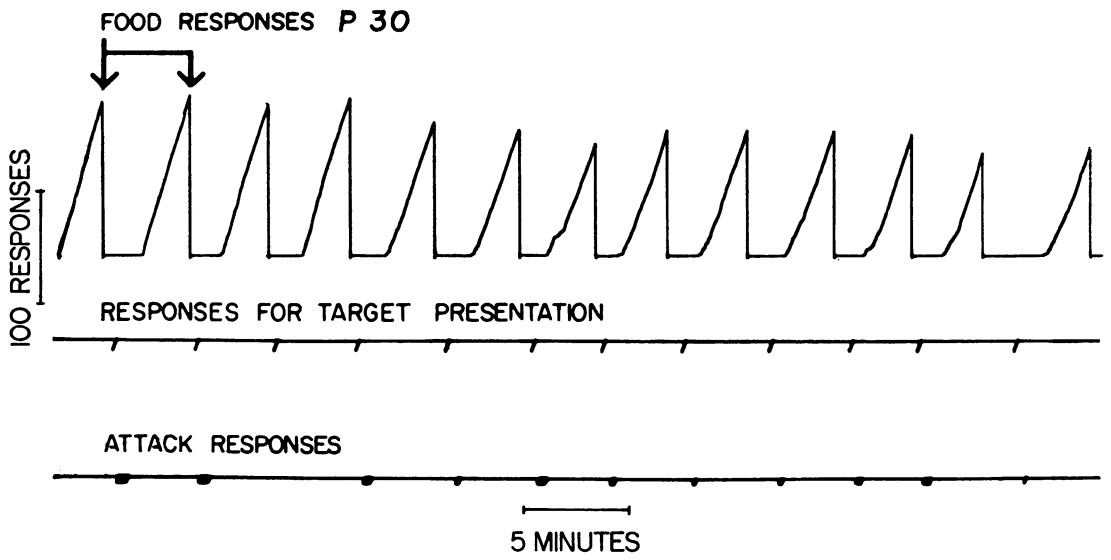

Fig. 2. Sample cumulative record for Subject P 30 responding on FI 2-min food and FR 2 target presentation schedules. Simultaneous recording of food key, target key, and attack responding are represented. Following presentation of food, the stepper pen reset to the baseline (top of figure). Attack responses are switch closures recorded when a force of at least 100 g was exerted against the front of the restraining box (containing the target bird) by the experimental subjects during periods of fighting. The target bird was accessible for 15 sec following completion of an FR 2 requirement on the target key.

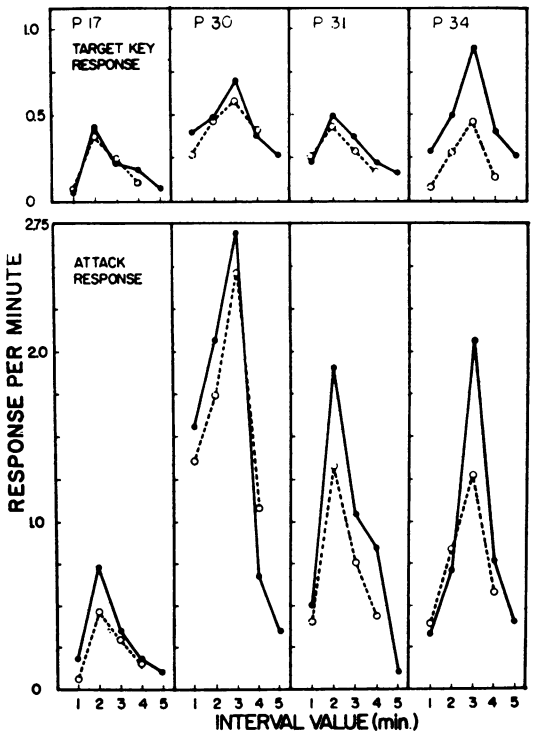

Fig. 3. Mean rate of responding on the target key and mean rate of attack responses as a function of the interval value of the food reinforcement schedule. The rates during initial exposure to the interval value (filled circle, solid line) and during the replication (open circle, dashed line) are plotted separately. Subjects were maintained at a given interval value for five successive sessions. The rates at the various interval durations represent the mean of the last three sessions.

EXPERIMENT II: RESPONDING MAINTAINED BY THE OPPORTUNITY TO ATTACK IN THE PRESENCE OR ABSENCE OF THE TARGET

The second experiment sought to determine if it was possible to extinguish and recondition responding on the target key by successively removing and then returning the target bird to the restraining box.

Method

Subjects

Pigeons P 30, P 31, and P 34 from Experiment I served.

Apparatus

The apparatus was the same as that described in Experiment I.

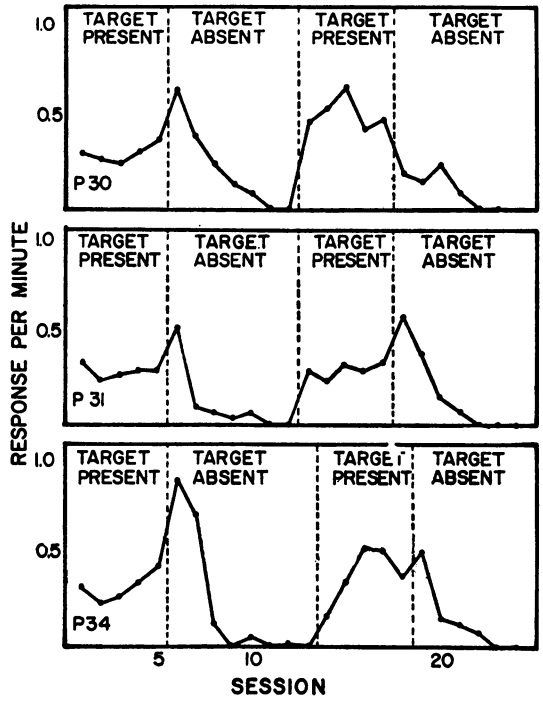

Fig. 4. The rate of responding on the target key in the presence and absence of the target.

Procedure

The procedure consisted of an ABAB design in which the target was either present in the restraining box (A) or absent (B). In the first condition, responding on one key was maintained on a response-initiated FI food reinforcement schedule, and responding on the second key on a FR 2 resulted in target bird presentations. The FI value of the food reinforcement schedule was the value during which response rates on the target key were highest in Experiment I (FI 2-min for Subject P 31; FI 3-min for P 30 and P 34). After five sessions, the target birds were removed. Responding on the target key continued to produce all the stimulus changes associated with target availability, except that the target bird was absent from the restraining box. Following this manipulation, the targets were again placed in the restraining box for five sessions; and in the final condition, the targets were again removed.

Results and Discussion

Rates of responding on the target key in the presence and absence of the target bird are shown in Figure 4. Removal of the target bird

from the restraining box resulted in first an initial increase in responding on the target key followed by a gradual decrease. After 6 to 8 sessions in which the target bird was not present, responding on the target key had decreased to zero. Returning the target bird to the restraining box resulted in a marked increase in responding on the target key. All three subjects showed a recovery of responding on the target key equal to the rate observed before the target bird was removed. A second removal of the target bird again decreased responding on the target key.

The extinction and reconditioning of responding on the target key observed in the present experiment, suggest that responding was maintained by presentation of the target animal.

EXPERIMENT III: RESPONDING MAINTAINED BY THE OPPORTUNITY TO ATTACK DURING RESPONSE-DEPENDENT AND RESPONSE-INDEPENDENT FOOD PRESENTATIONS

In the present experiment, the delivery of food was alternated between response-dependent (FI schedule) and response-independent conditions to determine its effect on responding on the target key.

Method

Subjects

Three male White Carneaux pigeons were used. Subjects P 17 and P 31 had been used previously; Subject P 41 was experimentally naive. A taxidermically prepared pigeon was used as a target with Subject P 41, and live targets were paired with Subjects P 17 and P 31.

Apparatus

The apparatus was previously described in Experiment I.

Procedure

The procedure was an ABAB design consisting of alternating periods of response-dependent (A) and response-independent (B) food deliveries. The subjects were studied for five sessions on a response-initiated FI food reinforcement and FR 2 target presentation schedule. The interval values were FI 2-min for Subjects P 17 and P 41, and FI 3-min for Subject P 30. In the second condition (B), the food key was covered and food was delivered independently of behavior. The interval between successive food presentations for each subject was equal to the mean interreinforcement interval calculated from the previous five sessions of the response-dependent condition (A). A 15-sec protective contingency between response-independent food presentation and either a response on the target key or the termination of target availability was in effect. Thus, food was not presented until 15 sec after each response on the target key or 15 sec after the termination of target availability. In the third condition (A), the food key was uncovered and food was again delivered on the response-initiated FI schedule. In the final condition (B), the food key was covered and food was again presented independent of responding. Under all conditions, the target bird was presented on an FR 2 schedule.

Results and Discussion

Rates of responding on the target key in both the response-dependent and response-independent conditions are shown in Figure 5. Subject P 17 showed a decrease in rate of responding on the target key across sessions in both conditions. Whether food was presented dependent upon responding on the FI schedule, or delivered independently of behavior seemed to have no effect on responding on the target key for P 17. With Subject P 30, responding on the target key was maintained in both conditions, and little or no difference in response rate was noted with either response-dependent or response-independent food presentations. A decreased rate of responding on the target key was observed in the response-independent condition with Subject P 41. A return to response-dependent (FI schedule) food presentation increased responding on the target key. When food was again presented independent of behavior, a decrease was seen.

The effect of response-dependent *vs* response-independent food deliveries upon the rate of attack responses was similar to that observed for responding on the target key (Figure 6). Subject P 17 showed a decreased rate of attack responses over daily sessions. The rate of attack responses for Subject P 30, was approximately the same in both the response-independent and response-dependent

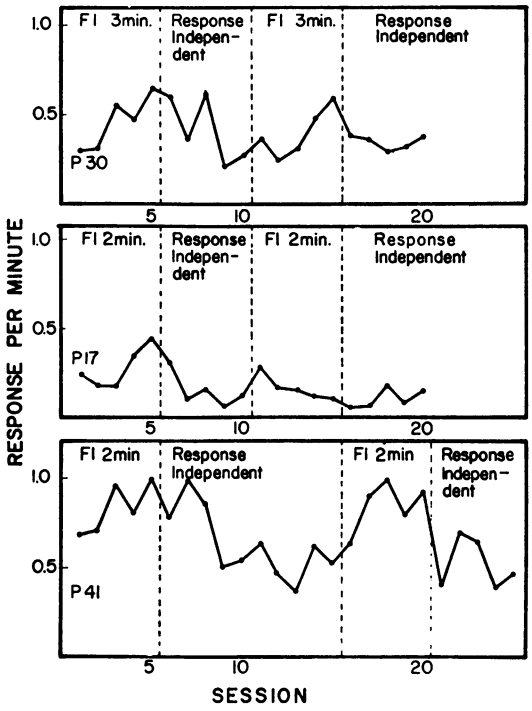

Fig. 5. The rate of responding on the target key in both the response-dependent (FI 2- or 3-min) and response-independent conditions. In the response-independent condition, the food key was covered and food was presented independent of behavior.

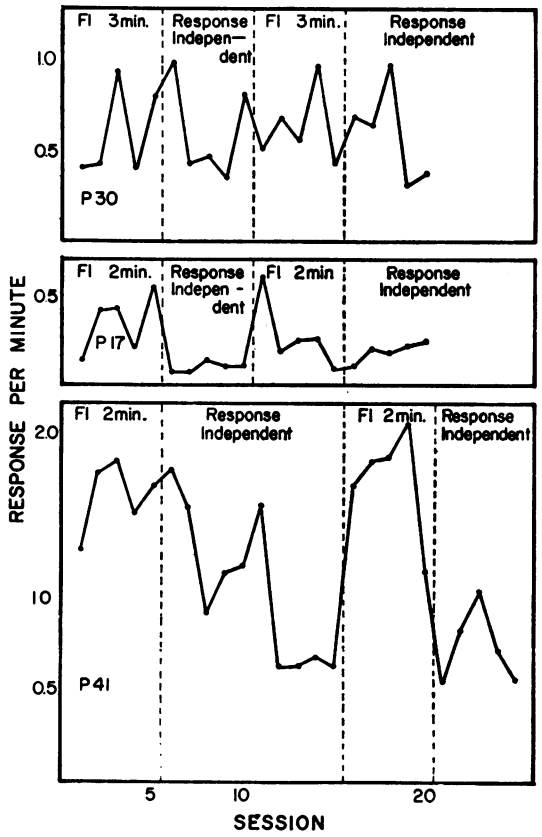

Fig. 6. The rate of attack responses in both the response-dependent (FI 2- or 3-min) and response-independent conditions.

conditions. A decreased rate of attack in the response-independent condition, was observed with Subject P 41.

Thus, it appears that under the conditions of this experiment, the presentation of food was sufficient to maintain responding on the target key. Rate of responding on the target key was either not changed or decreased when food deliveries were presented in the absence of any specified operant response requirement.

EXPERIMENT IV: RESPONDING MAINTAINED BY THE OPPORTUNITY TO ATTACK IN THE PRESENCE OR ABSENCE OF A CONCURRENT FOOD REINFORCEMENT SCHEDULE

This experiment attempted to determine if responding on the target key would be maintained in the absence of a concurrent food reinforcement schedule. Earlier studies have shown that pigeons cease to attack a target animal when they are no longer responding on ratio schedules of food reinforcement (Gentry, 1968), or when no longer exposed to alternating conditions of continuous reinforcement and extinction (Azrin *et al.*, 1966).

Method

Subjects

Of four male White Carneaux pigeons, two pigeons had been used in previous experiments (P 30 and P 34) and two were experimentally naive (P 40 and P 42). Subjects P 30 and P 34 were paired with live target birds, and a stuffed pigeon was used as a target with Subjects P 40 and P 42.

Apparatus

The apparatus was the same as described in Experiment I.

Procedure

After responses on the food key were shaped, the two naive subjects (P 40 and P 42) were stabilized on a response-initiated fixed-interval

schedule of 3 min and 2 min respectively (as in Experiment I). The procedure consisted of an ABAB design of FI food-reinforcement (A) and no-reinforcement (B) conditions. Subjects were studied for five successive sessions of concurrent FI food reinforcement FR 2 target presentation. In the no-reinforcement condition, the food key was covered and food was never presented. This was not extinction because the food-reinforced response could not be emitted. In the third condition, the food-reinforcement schedule was reinstated. Finally, the subjects were returned to the no-reinforcement condition. Under all conditions, responding on the target key (FR 2) resulted in target presentation.

Results and Discussion

Figure 7 shows rate of responding on the target key in the reinforcement (FI schedule) and no-reinforcement conditions. During the no-reinforcement condition, there was first an increase in the rate of responding on the target key followed by a gradual decrease to zero. Reinstatement of the food-reinforcement schedule resulted in an increase in the responding on the target key to a rate comparable to that observed in the initial condition. The rate of attack responses in both conditions is shown in Figure 8. The effects of the presence or absence of the food-reinforcement schedule on attack response rate are similar. The only point where the two rates do not show similar effects is in the initial exposure to the no-reinforcement condition, where there is a marked increase in responding on the target key, while the rate of attack responses decreased.

The results of Experiment IV indicated that responding on the target key was not maintained in the absence of a concurrent schedule of food presentation. Both rate of attack responses and responses on the target key decreased to zero when the food was no longer presented.

GENERAL DISCUSSION

The results of Experiment I demonstrated that the response-dependent presentation of a target bird can maintain pecking on one key when pecking on a second key is reinforced on a food-reinforcement schedule. Responding on the target key was successively extinguished and reconditioned by removing and returning the target bird to the restraining box (Experi-

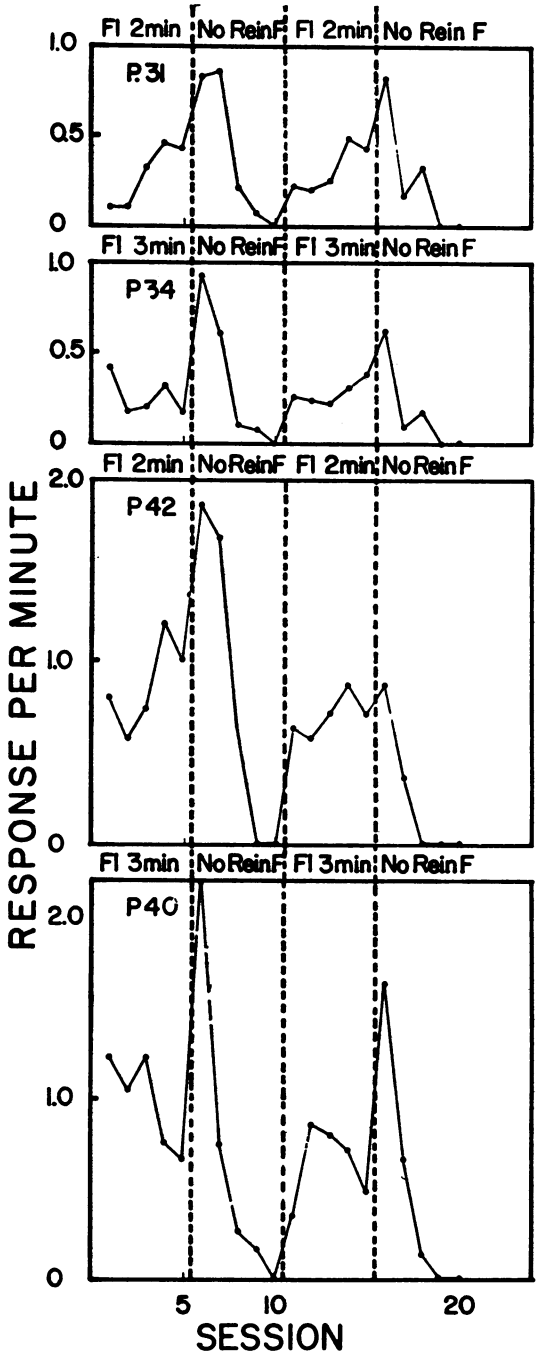

Fig. 7. The rate of responding on the target key in the reinforcement (FI 2- or 3-min) and no-reinforcement conditions. In the no-reinforcement condition, the food key was covered and no food was presented.

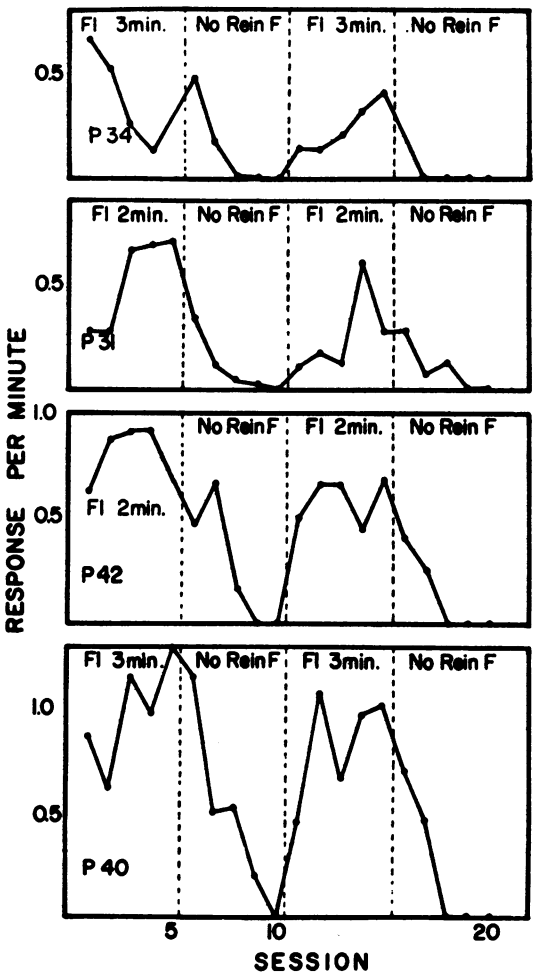

Fig. 8. The rate of attack responses in the reinforcement (FI 2- or 3-min) and no-reinforcement conditions.

ment II). Thus, presentation of a target animal, which can be attacked, can serve as a reinforcer and maintain an operant response.

The responding maintained by presentation of the target bird occurred almost exclusively during the post-reinforcement pause of the fixed-interval schedule. This is consistent with the distribution of attack responses that has been observed during fixed-ratio reinforcement schedules (Hutchinson, *et al.*, 1968; Gentry, 1968). The COD and the protective contingency, together with the temporal distribution of target key responses, seem to preclude the possibility that responding on the target key was maintained by adventitious food reinforcement. The relation between rate of responding on the target key and fixed-interval duration (Experiment I) corresponds with the report of a similar function between rate of attack responses and the interval between response-independent food presentations (Flory, 1969).

A response requirement is not necessary to generate attack in schedule-induced aggression. Transitions from a period of food presented independently of responding to a period in which no food was delivered produced attack in pigeons (Azrin, *et al.*, 1966). Flory (1969) demonstrated that the presentation of food at fixed intervals of time evoked attack in pigeons. Likewise, the intermittent presentation of food was sufficient to maintain responding on the target key and attack directed at the target bird (Experiment III).

The reinforcing effectiveness of access to the target bird is dependent on the conditions of the concurrent food reinforcement schedule. Responding on the target key was not maintained in the absence of a concurrent interval schedule of food reinforcement (Experiment IV). Azrin, Hutchinson, and McLaughlin (1965) reported that squirrel monkeys emitted a chain-pulling response that produced an inanimate object that could be attacked only when monkeys were receiving tail shock. Little or no responding occurred in the absence of shock. Similarly, Grabowski and Thompson (1969) demonstrated that the presentation of response-independent shock increased the rate of responding that leads to mirror presentation in Siamese fighting fish. These authors suggested that aversive stimulation (*e.g.*, shock) produces a situation in which the opportunity to attack is a reinforcing event. The phenomenon of schedule-induced escape suggests that intermittent schedules of food presentation possess aversive properties (Azrin, *et al.*, 1966; Falk, 1970), and the results of Experiment IV seem to support this, in that subjects responded for target presentation only in the presence of a intermittent schedule of food presentations.

Falk (1970) proposed that schedule-induced aggression, schedule-induced escape, and schedule-induced polydipsia should be included in a new class of behaviors termed "adjunctive". Responding on the target key in the present experiment meets Falk's definition of adjunctive behavior—"behavior maintained at high probability by stimuli whose reinforcing properties in the situation are derived primarily as the result of schedule parameters governing the availability of another class of reinforcers".

The reinforcing effectiveness of the opportunity to attack was dependent on the presence of a schedule of food presentations.

Other similarities between responding on the target key and those previously reported for polydipsia also support this proposition: (1) most responding on the target key occurred during the post-reinforcement pause of the fixed-interval schedule. Similar findings have been reported for polydipsia (Falk, 1961*a*); (2) a protective contingency or COD does not eliminate the adjunctive behavior (Falk, 1964); (3) the adjunctive behavior occurs if the food is delivered independent of behavior or if the food presentations are response dependent (Falk, 1961*b*); (4) during a concurrent food reinforcement schedule, responding can be maintained by the opportunity to engage in the adjunctive behavior (Falk, 1966*a*); (5) an "inverted-U-shaped" relationship exists between the rate of the adjunctive behavior and the interval value of a concurrent food-reinforcement schedule (Falk, 1966*b*). Falk reported a maximum rate of polydipsia at an interval value of 2 to 3 min, which corresponds to the maximum rate of responding on the target key at 2 or 3 min observed in Experiment I. The results of the present experiments indicate that the aggression generated by the interval food reinforcement schedule is an adjunctive behavior whose reinforcing efficacy is dependent upon the presence of a concurrent schedule of food presentation.

Falk (1970) discussed the similarities between adjunctive behavior and behavior termed displacement activities by ethologists. Displacement behaviors are described as occurring when certain environmental events result in the interruption of some consummatory activity (*e.g.*, eating) in an organism under high "drive" conditions. This is also the condition that produces adjunctive behavior, in that a deprived organism is prevented from continuing to eat or drink by the intermittence imposed by the schedule. A number of ethologists have inferred internal states that "force" a tendency to engage in aggressive behavior on the basis of the occurrence of aggression in situations where no identifiable eliciting stimulus is present. Aggression in these environmental contexts may arise as the result of the intermittent scheduling of another class of reinforcers in the situation. Thus, aggression can be viewed as behavior occurring in a particular stimulus situation, and not as a spontaneous behavior occurring as the result of hypothesized internal states.

REFERENCES

Arzin, N. H., Hutchinson, R. R., and Sallery, R. D. Pain-aggression toward inanimate objects. *Journal of the Experimental Analysis of Behavior,* 1964, **7,** 223-228.

Azrin, N. H., Hake, D. F., and Hutchinson, R. R. Elicitation of aggression by a physical blow. *Journal of the Experimental Analysis of Behavior,* 1965, **8,** 55-57.

Azrin, N. H., Hutchinson, R. R., and McLaughlin, R. The opportunity for aggression as an operant reinforcer during aversive stimulation. *Journal of the Experimental Analysis of Behavior,* 1965, **8,** 171-180.

Azrin, N. H., Hutchinson, R. R., and Hake, D. F. Extension-induced aggression. *Journal of the Experimental Analysis of Behavior,* 1966, **9,** 191-204.

Catania, A. C. Concurrent operants. In W. K. Honig (Ed.) *Operant behavior: areas of research and application.* New York: Appleton-Century-Crofts, 1966. Pp. 213-270.

Cherek, D. R. and Pickens, R. Schedule-induced aggression as a function of fixed-ratio value. *Journal of the Experimental Analysis of Behavior,* 1970, **14,** 309-311.

Falk, J. L. Production of polydipsia in normal rats by an intermittent food schedule. *Science,* 1961, **133,** 195-196. (*a*)

Falk, J. L. The behavioral regulation of water electrolyte balance. In M. R. Jones (Ed.) *Nebraska symposium on motivation.* Lincoln: University of Nebraska Press, 1961. Pp. 1-33.

Falk, J. L. Studies on schedule-induced polydipsia. In M. J. Wayner (Ed.) *Thirst: First international symposium on thirst in the regulation of body water.* New York: Pergamon Press, 1964. Pp. 95-113.

Falk, J. L. The motivational properties of schedule-induced polydipsia. *Journal of the Experimental Analysis of Behavior,* 1966, **9,** 19-25. (*a*)

Falk, J. L. Schedule-induced polydipsia as a function of fixed-interval length. *Journal of the Experimental Analysis of Behavior,* 1966, **9,** 37-39. (*b*)

Falk, J. L. *The nature and determinants of adjunctive behavior.* Paper presented at Symposium on Schedule-Induced and Schedule-Dependent Phenomena, Toronto, May, 1970.

Flory, R. Attack behavior as a function of minimum inter-food interval. *Journal of the Experimental Analysis of Behavior,* 1969, **12,** 825-828.

Gentry, W. D. Fixed-ratio schedule-induced aggression. *Journal of the Experimental Analysis of Behavior,* 1968, **11,** 813-817.

Gentry, W. D. and Schaeffer, R. W. The effect of FR response requirement on aggressive behavior in rats. *Psychonomic Science,* 1969, **14,** 236-238.

Grabowski, J. G. and Thompson, T. Effect of shock on mirror-reinforced behavior of betta splendens. *Psychonomic Science,* 1969, **15,** 173-174.

Guhl, A. M. The behavior of chickens. In E. S. E. Hafez (Ed.), *The behavior of domestic animals.* Baltimore: Williams and Wilkins, 1962. Pp. 96-108.

Hutchinson, R. R., Azrin, N. H., and Hunt, G. M. Attack produced by intermittent reinforcement of a concurrent operant response. *Journal of the Experimental Analysis of Behavior,* 1968, **11,** 489-495.

Lissman, H. W. Die umwelt des Kampffisches. *Zeitschrift fur Vergleischende Physiologie,* 1932, **18,** 65-111.

Mechner, F., Guevrekian, L., and Mechner, V. A fixed-interval schedule in which the interval is initiated by a response. *Journal of the Experimental Analysis of Behavior,* 1963, **6,** 323-330.

Smith, S. and Hosking, E. *Birds fighting.* London: Farber and Farber, 1955.

Thompson, T. Visual reinforcement in Siamese fighting fish. *Science,* 1963, **141,** 55-57.

Thompson, T. Visual reinforcement in fighting cocks. *Journal of the Experimental Analysis of Behavior,* 1964, **7,** 45-49.

Thompson, T. and Bloom, W. Aggressive behavior and extinction-induced response rate increase. *Psychonomic Science,* 1966, **5,** 335-336.

Ulrich, R. E. and Azrin, N. H. Reflexive fighting in response to aversive stimulation. *Journal of the Experimental Analysis of Behavior,* 1962, **5,** 511-520.

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